IV

CIVILIZATION AND THE MOTOR CAR

MOST of us join King David in believing that "the days of our years are three score years and ten; and if by reason of strength they be four score years, yet is their strength labor and sorrow; for it is soon cut off, and we fly away." In consequence, we try to crowd into our active years a maximum of those pleasures which attract us most. In this attempt, many of us are hampered seriously by the necessity of providing a living; but there are others more favored by fortune who find much of their joy in life in performing well, labors which poorer men would avoid if possible. In either case, since the effectiveness of our work has such an important bearing on our happiness, any time-saving or labor-saving invention of general application cannot fail to cause extensive changes in our daily lives. Any one could easily cite numerous examples in verification of this statement; but perhaps not every one has noticed that practically all of these inventions appeared either with the dawn of history or else within the last two hundred years. This fact is worthy of some attention.

During the thousands of years composing the history of man before the eighteenth century of our era, his regular daily life had varied only a little from century to century. Living conditions improved somewhat, it is true; but to persons living in the twentieth century, general changes in the life of the masses seem slow indeed until a century and a half ago. Before that date, all work was confined to

what could be accomplished by human or animal energy or by wind or water power. Facilities for travel or transportation were limited and uncertain; health and life itself were precarious; leisure and opportunities for education were the privileges of comparatively few people. For the majority of mankind, strenuous efforts were required simply to exist.

But almost coincident with the French Revolution, there began a change in industrial life as radical, as rapid, and as extensive in its effects as were the political changes of those days. In fact, historians commonly call it "The Industrial Revolution". It marks the beginning of a stage in human progress which future historians may well call the "Age of Power", for without mechanical power the industrial revolution would never have occurred; without power our present type of civilization could not have been attained; and without power we cannot imagine it continuing.

It was about 1770 that men began to learn how to control the steam engine, that gigantic slave of the nineteenth century whose labor-saving capacity was certainly one of the most potent forces moulding life during that period. Once men were able to secure mechanical energy from fuel, they could make widespread application of machines which lightened the daily burdens of countless workers. In proportion to the effect of these machines on the labor of men, the life of the world was altered. The daily working hours of industrial employees decreased from twelve or fourteen to ten, then to nine, then to eight, with even further decreases in prospect. The application of power to spinning, weaving, knitting, and sewing machines released millions of women and children from the drudgery of clothing manufacture—certainly the first step toward the general poli-

tical freedom of women. Locomotives and steamships made possible both extended travel and commerce and the settlement of productive new countries. And, when chemical or physical science pointed the way to new materials or new processes, mechanical energy for the work was available in constantly increasing quantities and at a price which made progress possible economically as well as theoretically.

In the past fifty years especially, progress in the application of power has continued at a bewilderingly rapid pace—a pace which seems to grow faster and faster. We have hardly time to learn the workings of one new device before our children are embarrassing us by questions on the operation of an improvement. Not only is this development extremely rapid, but its effects are experienced in all walks of life and in all parts of the world.

It would be hard to determine which type of power application has grown most rapidly or most widely; but excellent examples of such development may certainly be found in transportation—a field of activity which affects every aspect of our modern civilization. Since few of us come in close contact with steam railroad equipment, its progress has continued almost unnoticed. But with the development of the electric motor and the internal combustion engine we are more familiar. If they are not already installed in our houses or back yards, we meet them in some form every day. In the past fifty years of their life, these two younger brothers of the steam engine slave have raced so rapidly over the country, have quarreled so loudly, and have changed so many details in our daily lives that the most casual observer could not fail to notice their growth in usefulness. The combined effects of these two agencies have been especially striking in the field of city passenger transportation.

Forty years ago, transportation facilities for city dwellers were very little better than those enjoyed by the ancients. Street railroads existed, it is true; and the development of cheap steel for springs had made possible comfort for which kings must have sighed years ago; but as a means of motive power, the horse was still supreme. In two score years, this supremacy has been entirely lost. In spite of their centuries of use, horse-drawn vehicles have been very largely forced off of our city streets by successive attacks from cable cars, electric surface cars, elevated railways, subways, and finally automobile busses, taxis, and jitneys.

What became of those displaced horses? Were they perhaps absorbed by the rural districts? The census figures show they were not; in fact, the farms not only did not accept the city's horses, but actually substituted tractors, automobiles, and interurban railroads for their own animals. Between 1914 and 1923 the number of horses in cities decreased forty-six per cent.; but during the same period, the numbers in the country also decreased ten per cent. Over the whole nation, the number of horses decreased two millions, although the number of cattle increased ten millions in the same period. The value of horses decreased forty-two per cent. during a time when the value of other forms of livestock increased substantially.

As horses wore out, they were simply replaced by machinery fed with electricity or liquid fuels, thus making soil previously devoted to forage crops available for raising food for men. Since the produce from several acres is required to feed a working horse for a year, it is interesting although not pleasant to speculate on what the cost of living would be to-day if we had to feed with corn and

hay the horsepower required by our electric and gasoline vehicles.

These two forms of transportation were also largely responsible for the recent growth of our cities through the development of suburbs. Many of these additions could never have been served adequately by steam or animal motive power alone; but when electricity and gasoline made available cheap, quick, and clean suburban transportation, the man with a moderate income could move to the city, enjoy its facilities, and at the same time experience the freedom and health of the small town. Even the people living in the crowded parts of the city profited, because the decrease in the numbers of horses stabled near humans greatly simplified problems of health and cleanliness.

But there is one effect of this change to mechanical transportation which, though freely prophesied, has not yet come to pass. Although the number of horses we raise is steadily diminishing, the United States is still able to develop champion racehorses; and although the internal combustion engine has provided us with many thrilling spectacles in the shape of contests between speed-boats, aeroplanes, motorcycles, and automobiles, horse races still attract large crowds of enthusiasts.

This victory over the horse was won by electric and gasoline transportation acting together, and it would be difficult to say which of the two was the more responsible for changes in city life in the past forty years. But in the case of rural life, no such difficulty appears. The major part of the world's population still lives in districts far removed from supplies of cheap electricity, although easily accessible to wheeled vehicles. In such localities, the ability of the automobile to carry its own supply of energy gives it an insurmountable advantage over the electric machine.

Even the comparatively independent trolley busses or trackless trolleys, now operating in eight American cities, cannot leave their wires far behind, for we have not yet been able to produce electricity in a sufficiently concentrated form for propelling automobiles. Storage batteries require careful attention, and by their weight and bulk they seriously limit the speed, capacity, and range of action of automobiles. Gasoline, however, carries energy in a very concentrated form. If we imagine an automobile which can make twenty miles on a gallon of gasoline drawing this fuel through the carburetor in a circular jet of liquid twenty miles long, the diameter of this thread would be only three and one-half thousandths of an inch. Gasoline contains sixty per cent. more energy than an equal weight of coal, and the apparatus for liberating this energy is surprisingly light and compact.

Because the gasoline automobile can go wherever roads exist, carrying its own supply of fuel, and because it is cheap, powerful, speedy, reliable, and easily handled, it has caused very serious changes, both good and bad, in our physical surroundings, habits, morals, international relations, and in a score of other ways. Because of the extent and rapidity of these changes, they require recognition and control.

In no country are these changes so noticeable as in the United States. Although the automobile was first manufactured in quantities in France, ninety per cent. of the world's supply is now produced in America. Last year we built more than four million vehicles—fifty per cent. more than in 1922. This year we shall probably make five million cars—an increase of twenty-five per cent. Last year the products of the automobile and tire industry were valued at five billion dollars; this year the figure will probably be

seven billions. The production of so much wealth of this sort cannot fail to have serious effects on our lives. For one thing, the manufacture of automobiles, tires, and accessories furnishes employment for two and three-quarter million American workers. This number increases to three and a half or four millions if we include chauffeurs, oil refinery workers, and the men engaged in constructing buildings and in supplying materials for automobiles. From these feeder industries, the new automobiles alone require two and a half million tons of steel annually, while the whole automobile industry in all its branches consumes six million tons annually—a quantity which is about ten per cent. of our total steel production and is equivalent to more than half the output of England. Automobiles in California carry in license plates alone about five hundred tons of steel. Twenty-five per cent. of our aluminum and fifty-four per cent. of our upholstery leather goes into motor cars. Windshields and windows require thirty-six per cent. of our plate-glass supply.

But Americans do more than monopolize the manufacture of automobiles. They keep most of them for their own use. Nowhere else in the world are there so many automobiles, either in total numbers or per capita. There exist in the world to-day something like seventeen million automobiles and trucks, of which over fifteen millions, or eighty-nine per cent., are registered in the United States. The whole continent of Europe contains only about one and a half million, or about nine per cent. of the world's supply. The United Kingdom, which is the second country in the world and the first in Europe in point of number of motor cars, contains less than seven hundred thousand vehicles, or a trifle more than the number registered in Texas and about half the number registered in New York State.

In Great Britain, there is one automobile to a hundred people; in Texas the ratio is about one to nine; in the United States it is one to seven; in California it is one to four.

Because America contains such a very large proportion of existing automobiles, we should be careful not to expect in other countries changes which are general in the United States. And in predicting future changes due to the automobile, we must remember that opportunities for change may differ in old countries and in new ones like America.

For example, one of the effects of the motor car most noticeable in this country is our extensive and costly programme of highway improvement. On the continent, development of this character has not been marked lately because many existing highways have proved satisfactory for the amount of motor traffic they carry. The foundations of their highways are old and firm, and their drainage and maintenance systems are the envy of American engineers. Excellent national highway systems have existed in Europe for many years; but in America we did not have even one good transcontinental road before 1913. In that year, we began in earnest to build the thirty-three hundred mile Lincoln Highway between New York and San Francisco.

As soon as the cheap automobile became well developed, an increasingly powerful incentive to permanent, well-planned highway construction was joined with an excellent opportunity; and the result was a road-building record which lately has really been wonderful. The past four years have seen more roads surfaced than all the preceding years of American history. To-day we have four cross-continental highways, passable most of the year, and about four hundred and fifty thousand miles of improved roads. At the present rate of construction, we shall double our

improved-road mileage in ten years or less. This sounds very encouraging until we learn that we are doubling our automobile registration in only four years. Because the number of motor cars increases so much faster than our highway mileage, even our present excellent road-building record may have to be exceeded.

Of course, such elaborate improvements cost us a good deal of money. Last year new construction contracts totalling eight hundred million dollars were awarded; and if the cost of maintenance and improvements on existing roads is added to this sum, the total highway bill of the United States for last year becomes one and a quarter billion dollars. Was this expenditure justifiable?

We must look to the automobile for the answer, because however desirable hard-surfaced permanent roads may be, our diminishing numbers of horse-drawn vehicles certainly do not require highways of the type we have been constructing. Data from all over the country enable us to answer: "Yes; costly roads are justified if the motor traffic is heavy enough." Under these conditions, the investment is returned in the shape of increased safety, longer life of the road surface, greater speed and comfort, and very considerable savings in fuel and automobile materials and repairs.

The gasoline savings are especially interesting. Investigations show that in general gravel or macadam roads in good condition require from the automobile at least ten per cent. more fuel per mile than concrete or asphalt roads, and that such roads when in poor condition often require much more than thirty-five per cent. increase in gasoline consumption. The fuel-saving possibilities of good roads may be demonstrated in this manner: on a mile of gravel road over which the traffic was at the rate of one thousand automobiles a day, the gasoline consumption was figured

as being sixty-eight hundred gallons a year more than if a smooth surface permanent road were used. If the price of gasoline had averaged twenty-two cents a gallon during this year, the saving on fuel alone would have been fifteen hundred dollars a year, or perhaps one-fifth of the first cost of the road required to effect this economy. Since the gasoline saving depends seriously on the number of automobiles using the road per day, only very popular roads could be paid for out of fuel savings alone; but, on the other hand, many costly accidents are due to unexpected tire failures or similar effects of poor roads. Although tire wear is hard to measure with accuracy, good roads are said to have added as much as forty-five hundred miles to the lives of casings; and no one can doubt that immense savings in wear of all sorts are possible.

On the whole, few people doubt that good automobile roads are paying investments—investments which help decrease the cost of living and increase both national security and our individual pleasures. We do not worry so much over the size and steady growth of our road-building appropriations as over the efficiency of their investment and the methods of distributing the cost of these highways between heavy trucks, light cars, and persons not owning motor vehicles. We see highways constructed which wear out before they are paid for, sometimes because of poor construction, sometimes because of poor finance. Landowners object to paying for roads destroyed by automobiles and call for maintenance by means of high registration fees or gasoline taxes. Operators of light cars claim that most of this taxation should fall on heavy vehicles, and owners of trucks allege that they are already taxed excessively. Through our need for automobile highways, the motor car

has brought to the engineers and legislators enough new problems to keep them busy a long time.

In America, this road-building boom was caused by the general use of the automobile. Then why is it that in Europe, where roads were excellent at the time the motor car was developed, the automobile is less popular than in America? The answer is found in the relative cheapness of American cars. The system of quantity production common in our factories makes possible selling prices considerably below those of European makers. Deliberate attempts have been made by Mr. Ford and several other American manufacturers to produce a car suited to people of moderate incomes. These manufacturers base their plans on two well-known principles: first, that the lower the selling price the larger the number of people able to afford cars, and second, the larger the annual production of standardized cars the greater the economies possible in manufacturing. Their attempts have met with such enthusiastic approval from the public that prices have been reduced again and again, each reduction placing the cars within the reach of more and more people. Moreover, improvements in design, materials, and manufacturing processes have continued steadily throughout this period; so that to-day the automobile is one of the few things which costs us less than before the war. If the 1924 dollar is used in defraying living costs, it buys commodities which in 1913 cost only sixty-two cents; but if it is used to buy automobiles, it will purchase one hundred and twenty-three cents worth of 1913 value.

Many of the improvements which caused this decrease in cost were shared with other industries. Just as bicycle manufacturers developed processes useful to automobile manufacturers, so progress in automobile engine design gave the aeroplane engine a running start. The experiments of

the automotive engineers contributed a great deal to our knowledge of the heat-treatment of metals, the possibilities of aluminum and alloy steels, better methods of forging and pressing metals, factory management, labor control, and so on. In a thousand different ways entirely unconnected with automobiles, these improvements have increased our comfort and our leisure.

But in Europe, the manufacturing situation is very different. Since very few automobile makers have attempted to find a market outside the wealthy classes, low priced cars are scarce. Many European automobiles, especially the French cars, are produced by factories specializing in other products than automobiles; and since their production is small, it is not strange that their manufacturing costs are high even when they have the advantage of low wages. The importation of American cars is made difficult by unfavorable exchange, duties, embargoes, and the absence of service facilities, and the American manufacturers have not made serious attempts to operate very large foreign plants. It is true that the largest automobile factory in the British Isles is the Ford Motor Company's plant at Manchester, but what is its output of thirty thousand cars a year compared to the two million cars produced annually in Mr. Ford's American plants?

Another condition which makes the automobile more easily secured by Americans than by Europeans is the relatively high wages paid here for a given class of work. During the past nine years, Americans have enjoyed considerable prosperity, and the difference between European and American wages has become greater and greater. Not only are cheap automobiles available here, but they are less of a luxury for a given class of men than in countries where a narrower margin exists between income and necessities.

But even if automobiles were much more expensive than at present, the advantages of speed and rapid starting justify the use of motor vehicles by others than the wealthy. The old steam fire-engine, with its plunging horses and its trailing plume of smoke and sparks, was both picturesque and useful in its day; but the speed and power of the modern automobile truck carrying rotary pumps driven by gasoline engines has caused every city in the country gradually to replace its horse-drawn fire-fighting equipment with motor units.

Such emergency devices as physicians' cars and ambulances are in the same class as fire-fighting equipment. How many doctors own a horse to-day? And the horse-drawn ambulance, like the horse-drawn pumper, has practically disappeared from our streets. To-day even Houston's dog and cat ambulance is propelled by gasoline.

Another emergency use of the automobile appears in time of war, when one truck hauls the load of half a dozen horses at four times their speed, on a much more concentrated type of fodder, and into gas, confusion, and restricted quarters where horses would be difficult to handle. If proofs of their military value were needed, any number might be cited from the World War. Probably those best known to Americans are the aid furnished by the Parisian taxicabs at the first battle of the Marne, the supply of Verdun by motor vehicles, and the rapid transfer by truck of the American First Army from the St. Mihiel sector to the Argonne. Our opponents, the Germans, were seriously handicapped in this field by their need for petroleum and rubber substitutes; but in spite of this weakness, the Allies thought best to demand five thousand trucks in the equipment surrendered under the Armistice terms.

Fortunately for us, life is not yet made up entirely of

emergencies, in spite of its speed. Fires and ambulances and wars do not meet us every day, but commerce does; and in civilized countries wherever you have commerce, there you meet gasoline vehicles. In commerce, cost of operation is of first importance.

Twenty years ago, the high cost of motor vehicles almost prevented competition with horse-drawn business vehicles; but to-day, the only conditions favoring the horse are very frequent or prolonged stops, light loads, or extremely bad roads. The decreased cost of operating automobiles and the increased wages of men, acting together, are responsible for the great fleets of delivery trucks, automobile busses, and taxicabs in commercial service. Owners realize that if the automobile saves enough of the time of passenger or driver, it is an investment paying dividends in terms of wage-savings even when its first cost is considerable. The same argument justifies the use of trailers and detachable bodies. Of course, a certain part of these commercial savings are passed on to the ultimate consumer and affect the cost of living.

Even when a business man does not own private automotive vehicles, he can secure their economies through public truck or bus lines. Both classes of service appeared in thickly settled parts of this country about 1910; and in sections much frequented by tourists, such as California and Florida, the bus lines became very popular. To-day, we have about fifty-one thousand of these vehicles in service. For short-haul freight work, the motor truck offers many advantages. Since freight can be carried direct from shipper to consignee, there is less handling and consequently less breakage. There are fewer delays in transit or while waiting for empty cars, and there is less expensive equipment tied up in congested terminals. The truck operators

also have no expenses for purchase of private right-of-way, and until a few years ago there were comparatively few legal restrictions on either bus or truck lines. These last two advantages seem likely to be diminished considerably, for both railroads and taxpayers object to them. The taxpayer admits the desirability of low transportation costs, but he thinks the damage done to highways by heavy vehicles is greater than the tax paid by their operators. The railroads claim that competition with transportation agencies partially subsidized by the public is unfair to them and that the responsibility for continuous service and for accidents is unequal. The private driver and the pedestrian also have their personal troubles with the chauffeurs of vehicles whose size and weight encourage independence.

These difficulties are very like those existing between the electric street-cars and the jitneys. In each case, where competition has been keen there has resulted a certain amount of depreciation in quality of railroad service and a very noticeable decrease in new railroad extension. We are certainly reluctant to give up the advantages of the motor vehicle for short hauls and special service; but on the other hand, we are unable to do without the railroads for long hauls. The ideal arrangement would be a combination of the two services according to their peculiar abilities, turning over to responsible well-regulated motor companies service in inaccessible territory not paralleling railroads, the work of branch-line feeders, freight hauls of less than twenty-five miles, and the transfer of less than carload shipments between terminals in the same city. Such coöperation seems to be growing in popularity, for at the beginning of this year two hundred and sixty-four steam and electric railroads were using motor trucks to some extent for freight or passenger service. The Pennsylvania Railroad is a

prominent member of this group. The results, as far as they have been reported, seem in general to be a small increase in profit for the operating company and a considerable increase in convenience and service to the public.

But not all automobiles are used for emergency or for commercial use. In the United States, there are seven and a half pleasure cars for each automobile truck, and even in Europe the trucks are outnumbered two and a half to one. Why have men purchased so many machines not necessary to their business, even when used for business at all? It is true that automobiles are comparatively cheap in the United States, but even Americans would not spend so much money on motor vehicles without hope of a considerable return of some sort.

In the case of the strictly pleasure car, this gain is often a saving of time and energy for other pleasures; but the automobile also makes its own peculiar contributions to worth-while recreation. What other form of highway travel makes fewer demands on the driver? What other form of transportation of any sort yields more easily to the whims of the traveler? This freedom from limitations and worries seems to be the automobile's chief attraction to the tourist. In its enjoyment, millions of Americans of all classes find health, recreation, and education. The demand for tourist service and the tremendous numbers of motorists visiting our national parks is conclusive evidence of the popularity of automobile touring as an American vacation.

Independent control of cheap, speedy transportation is also of prime importance to persons living out of touch with rail facilities. Twenty years ago, farmers were forced to depend entirely on horse-drawn vehicles for transportation between the farm, the market, the church, and the

school. To-day, twenty-eight per cent. of American automotive vehicles are used by farmers. Only those who have lived in the country before the advent of the automobile can appreciate the blessings brought to the farmer by the cheap motor vehicle. In point of time, it decreases distances to one-half—perhaps to one-fourth. In consequence, wholesome recreation—a rare thing in so many rural communities—is much more readily secured, and farm labor becomes more easily retained. In almost every rural community, the automobile prolongs the school days of farmers' children; and in 12,500 American districts it is possible to supply at a reasonable tax, free transportation to consolidated rural schools with superior facilities. Without doubt, the automobile gives the farmer business advantages of many sorts; but the social advantages it brings him are very considerable also. Since half our population still lives in rural districts, these social and educational advantages may well be more important to the nation as a whole than the improvements made by the automobile in the farmer's economic condition.

But not all of the automobile's effects are good ones. This is not surprising, for history tells us that most labor-saving devices exhibit this two-edged characteristic to some extent. They result in leisure; and like leisure, they are as readily turned to destruction as to construction. Many labor-saving devices have provoked labor riots and economic disturbances, and it sometimes appears as if the most innocent inventions cause the greatest disturbances. The invention of the cotton gin made slavery profitable and aggravated sectional differences into a long civil war—a war made more destructive than previous conflicts by those same improvements in transportation which opened the West to settlement, by new and abundant metals developed

for peaceful applications but equally useful for ordnance and armor, and by the beginnings of the interchangeable system of manufacture. Two months ago, one of our best periodicals stated that the largest single factor leading to the World War is not traceable to Napoleon or Bismarck or the ex-Kaiser, but to the steam engineer, James Watt—a member of a profession notorious in the past for its lack of political activity.

The automobile can furnish many contrasts of this character. Although in rural education it certainly plays a useful part, in higher education its utility is at least doubtful. In discussing this subject, certain northern college executives have expressed opinions which a local newspaper printed under the expressive headline, "Gasoline and midnight oil do not mix." And in the field of public morals as well as in education, we find the automobile commended for some effects and severely condemned for others. The farmers of Fort Bend County accuse Houston automobilists of all sorts of wanton trespasses. Most of these offenses are minor, irritating ones, but the motor car makes so easy escape from the consequence of broken laws that criminals of all classes find it a useful tool. It is very properly charged with a large share of responsibility for the lawlessness of the present day. It is also charged with a reduction in the popularity of church-going and with the supposed loosening of family ties.

But there are certainly arguments on both sides of these questions. What if the bank robber and bootlegger do find the motor car a useful tool? Cannot the police use it also? It is true that stealing automobiles is a thriving new criminal business; but in the days before the automobile, was it not necessary to provide drastic punishment for horse-thieves? Now that out-of-town excursions are so

easily arranged, persons yield to the temptations of the links, the fishing party, and the picnic who might otherwise have attended helpful religious exercises; but are there not still others who attend such meetings only when aided by the same mechanism? Besides, no one really knows whether the automobile actually decreases church attendance or not. A man's opinion on this subject seems to depend on whether he tries to park his car near a church or a country club.

Regarding the effect of the automobile on family life, it can be said that the motor car may not only carry the young people away from home, but may with equal facility carry their parents right along with them if the older people make themselves pleasant enough. Home life is not strictly house life; and it is always doubtful whether life in a household from which one cannot escape has any value as family life.

Another serious charge is that the automobile becomes in many ways a party to waste and extravagance. For example, pleasure cars, like clothing, go out of style and for that reason may be discarded long before they are worn out. Again, the ownership of a car carries with it a certain social prestige and may provoke a certain amount of envy—two things for which many people are willing to pay a high price. These attractions, plus the genuine advantages of motor cars, have sometimes induced the purchase of automobiles by persons whose income did not justify this expense. Burdensome mortgages and sacrifices of various sorts are the result.

Sometimes the sacrifice is large families. Doubtless there are many comforts or luxuries aside from the automobile which convince the upper and middle classes of America that children are expensive luxuries; but the motor car certainly plays a part in the voluntary limitation of many a family.

At least one popular household magazine holds that the annual cost of owning, maintaining, and replacing a medium-priced pleasure car would amply cover the expense of rearing a healthy child to a self-supporting age.

On the other hand, the automobile has helped the cash-and-carry store to bring back to many people the old economical habits of personal marketing and cash payments —two habits which the telephone, the credit account, and the delivery service seemed for a time to be seriously diminishing.

In many ways, the careless use of the automobile results in the destruction of valuable material resources. Even when a car is being used for serious purposes, it may easily be hurrying us unnecessarily toward the exhaustion of our petroleum resources and the complication of our international problems. Every car with a smoking exhaust is consuming irreplaceable resources in the shape of wasted gasoline or lubricating oil. The automotive engineers realize this danger and have done astonishingly well in designing automatic devices which minimize the waste due to ignorant or careless drivers. The general public, however, is still unimpressed with the danger, even though it grumbles at the cracked and blended fuels which necessarily have taken the place of the old volatile straight-run gasoline. Because of this waste, it is still an open question whether our cheap automobiles with simple carburetors are not furnishing us with transportation at too dear a price.

Even if our gasoline were all used efficiently, we should require immense quantities of it. Last year we used seven and a half billion gallons and exported eight million gallons also. Moreover, our consumption increases rapidly. The gasoline production in 1923 was twenty-six per cent. more than in 1922. Is it any wonder that we have already used

up forty per cent. of the fifteen billion barrels of crude oil which once formed our national reserve? If this consumption continues at the 1923 rate, our visible supply of crude oil will be gone in twelve years. We produce two-thirds of the world's oil supply at the expense of a depletion in our own reserve of at least five per cent. annually.

Do these figures mean that American internal combustion engines are doomed to an early death from starvation? No, for perhaps we may still supply them by importing petroleum or by developing other kinds of fuel. Unfortunately, we do not have at present satisfactory substitutes either for gasoline, fuel oil, or worse still, for mineral lubricants; but on the other hand, the technical bureaus of the United States government and many scientific organizations clearly realize the danger of this situation and work diligently to improve it. Not only do they preach to the individual consumer economy of existing supplies, but they work constantly to eliminate loss during oil production, refining, and transportation, and to develop substitutes such as shale oil, benzol and alcohol, powdered coal, and so on.

If these substitutes are not forthcoming soon, we may still be able to buy oil from other countries—if they will sell to us. In 1922, the petroleum reserve of the world was estimated at seventy billion barrels, of which the United States possessed nine billions. In addition, we control most of the Mexican production; but even so we can rely on only eighteen per cent. of the world's supply. The remaining eighty-two per cent. is in the hands of other nations —seventy per cent. of it in the hands of Great Britain. When our supply is gone, will Great Britain sell to us?

The answer depends on both the political and the economic situations. There are many reasons why every civilized nation must have large supplies of petroleum; and in

the scramble for existing fields, a good many serious political problems have already arisen. Automobiles, industrial furnaces, aeroplanes, power-plants, submarines, and ships of all sorts must be supplied with fuels and lubricants both in peace and war. Oil fields rank in importance to-day with coal, iron, and nitrate deposits; and since petroleum is such an important weapon in both economic and military struggles, it would not be surprising to see embargoes placed on its export or wars fought for its possession. Although the automobile could not be charged with the whole responsibility for such a situation, its needs would certainly be an important contributing factor.

Another material consumed chiefly by the automobile and looming as a possible cause of foreign disagreements is rubber. Here again the automobile is not the only consumer. Rubber is essential for gas masks and for surgical, electrical, and scientific equipment; but three-quarters of the world's production goes into automobile tires. Moreover, most of this rubber comes to America for fabrication, the American tire-makers alone consuming two-thirds of the world's production. Last year, our output was forty-five million tires —three for each automobile registered. Now rubber cannot be produced in this country in any quantity, and the existing plantations are almost entirely under the control of other nations, especially Great Britain. It has been suggested that we should retain control of the Philippines and Santo Domingo and grow rubber in them for our own protection. Without doubt, a shortage of rubber would be a serious blow to us. One of our larger industries would be destroyed completely, and pleasure cars would be almost a thing of the past; but worse still, our army would be seriously injured.

This condition actually existed in Germany during the

World War. Although in 1912 her chemists had been confident of their ability to produce a satisfactory supply of synthetic rubber, in 1918 her trucks were running on slippery steel tires backed with inadequate shock absorbers, and thousands of the soldiers fighting for the nation which initiated gas warfare were dying for lack of proper gas-mask material. Great Britain's control of the world's rubber and petroleum resources has certainly created a situation full of interesting possibilities to the nation which leads the world in automobile use and manufacture.

Still another count against the motor car is its high accident rate. The insurance recorders tell us that fifteen thousand lives were lost in automobile accidents in the United States in 1923; but this figure is certainly too low, as most of us understand automobile accidents. The statistical method of classifying collisions holds the heaviest vehicle responsible. Thus, if a careless driver and his family are killed on a railroad grade-crossing, the records show a fatal railroad accident. Since we kill thirteen hundred people and injure four thousand more at grade-crossings annually, fifteen thousand deaths is not too many to charge against the motor car; but even on this favorable basis, the automobile is responsible for two-thirds of all the deaths caused by vehicles. This figure is four times the number of deaths caused by steam railroads and seven times the number caused by street railways. The remainder of the deaths caused by vehicles are due chiefly to the motorcycle, for as an accident maker, the horse is thoroughly passé.

A newspaper paragrapher has said that humanity is divided to-day into two classes: the careless and the carless; but if the pedestrian were not a good deal at fault, we should not find so many cities passing jay-walking ordinances and similar protective legislation. On the other hand, sta-

tistics show clearly that most often the blame for automobile accidents should rest on the driver. A recent Massachusetts report showed that seventy per cent. of their automobile fatalities were caused by the motorist and only twenty-four per cent. were due to the pedestrian. Excessive speed caused thirty per cent. of these deaths. Wisconsin reports reckless driving as the cause of fifty-five per cent. of her 1923 motor accidents.

The only encouraging thing about the situation is that although automobile fatalities seem to increase at the rate of about one thousand deaths a year, the death-rate per ten thousand automobiles registered is decreasing. Our traffic regulations and our educational campaigns among school children, motorists, and pedestrians seem to be having an effect. One safety slogan reads, "The best safety device is a careful man"; and the best way to manufacture such a device is by persistent instruction—if necessary, by compulsory education in a severe court.

In 1924, about a million people will be driving their first cars over our streets and highways. How shall we know that they are fit to assume this responsibility? How many of them will be children? In twenty-six States, anyone is allowed to drive a car so long as the machine carries a registry number. The education, examination, and licensing of all drivers by some system uniform throughout the nation is a precaution very seriously needed in America.

But although ignorance and carelessness are to blame for most of our automobile accidents, the situation is certainly aggravated by the design of our cities. Fortunately, many of these are still young and changing; and the automobile may very possibly have sufficient influence to force improvements. It has already shown its power to cause city growth in both area and population, and now it enforces its demands

for wider and smoother business streets by traffic jams and by a mounting accident rate. The remedies for traffic congestion seem to be: the widening of streets where possible, the use of one-way regulations where widening is impracticable, the dilution of traffic by the paving of streets parallel to main arteries, and the general speeding up of vehicles by control systems like the one now in use on Main Street in Houston. Elevated sidewalks for pedestrians and vehicular subways in business districts have also been suggested. Perhaps these second-story sidewalks will also carry the moving platforms recommended twenty-five years ago by Mr. H. G. Wells and now being actually tried out in England and Jersey City.

Parking difficulties are less easily remedied than traffic congestion. In business districts, no-parking zones are tolerable if ample parking facilities exist on waste land not too far away. One-hour parking zones are nuisances in many ways and are of limited application. Second-story and basement storage helps somewhat; but up to date, no really first-class or general remedy has been discovered. Parking difficulties and the accident rate together are strong allies of the street railroad and sources of much concern to the automobile manufacturer.

It is entirely impossible to discuss in one hour all the effects of the motor car on our daily lives. Many of them merit individually the use of all the time allotted to me. Some can only be mentioned. Examples of such minor effects are the introduction into our ordinary vocabulary of many new words, chiefly of French origin; a widespread interest in machinery and a better general knowledge of it; perhaps some adverse changes in our physique and perhaps a quickening of our thoughts and reactions; the transportation of sportsmen into the field much oftener than in past

years, with a serious effect on our wild life; a certain amount of assistance to scientific discovery and exploration in China, the Sahara, and the Antarctic region; and so on. The list is almost endless; and throughout its whole length we find evil mixing with the good. Will these faults restrict the future popularity of the automobile? The answer depends to a considerable extent on the individual car-owner. He is the only man who can really prevent gasoline waste and personal extravagance, and he can do much individually to prevent crime and accidents. His personal efforts, if guided by imagination and foresight and aided by his motor clubs and legislature, may perhaps postpone for many years our arrival at the long-expected automobile saturation density.

JOSEPH H. POUND